

determined to be a forbidden hop channel when the interference exceeds a threshold value. In response to the interference determination the selected hop channel may be included in a set of forbidden hop channels or may be removed from the set. In other embodiments, a selected hop channel may be compared to a set of forbidden hop channels to determine whether it is allowable or forbidden.

[0012] In other embodiments, a substitute hop channel may be selected among a sequence of hop channels using a time-varying parameter such as a clock value, a randomly selected value, pseudo-randomly selected value, or a non-random value or a time-fixed relationship between a forbidden hop channel and a substitute hop channel may be used.

[0013] In this manner methods and apparatus may be provided that allow a scanner device to determine whether a hop channel is forbidden or allowable and to avoid monitoring forbidden hop channels for paging messages. Communication links with a paging device may be established more quickly.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] **FIG. 1** is a block diagram of a frequency hopping communication device according to embodiments of the present invention.

[0015] **FIG. 2** depicts exemplary hop carriers in the ISM band.

[0016] **FIG. 3** is a timing diagram for establishing a connection between two communication devices according to embodiments of the present invention.

[0017] **FIGS. 4(a) and 4(b)** depict exemplary hop carriers in the ISM band with narrowband interference and with interfered carriers removed, respectively.

[0018] **FIGS. 5(a) and 5(b)** depict exemplary hop carriers in the ISM band with wideband interference and with interfered carriers removed, respectively.

[0019] **FIG. 6** is a table showing allowed and forbidden channels in a sequence of hop channels.

[0020] **FIG. 7** is a block diagram of a hop selection circuit according to embodiments of the present invention.

[0021] **FIG. 8** is a flow chart of operations for selecting substitute channels according to embodiments of the present invention.

DETAILED DESCRIPTION OF INVENTION

[0022] The present invention will now be described more fully with reference to the accompanying drawings, in which typical embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to like elements throughout.

[0023] According to some embodiments of the present invention, apparatus and methods for adapting hop sequences during the establishment of a connection between frequency hopping communication devices may be provided. **FIGS. 1-8** illustrate exemplary apparatus and opera-

tions according to various embodiments of the present invention. It will be understood that operations depicted in the figures, and combinations thereof, may be implemented using one or more electronic circuits, such as in one or more discrete electronic components, one or more integrated circuits (ICs) and/or one or more application specific integrated circuits (ASICs) and/or application specific circuit modules, as well as by computer program instructions, which may be executed by a computer or other data processing apparatus, such as a microprocessor or digital signal processor (DSP).

[0024] The computer program instructions may also be embodied in the form of a computer program product in a computer-readable storage medium, i.e., as computer-readable program code embodied in the medium for use by or in connection with an instruction execution system. The computer-readable storage medium may include, but is not limited to, electronic, magnetic, optical or other storage media, such as a magnetic or optical disk or an integrated circuit memory device. Accordingly, **FIGS. 1-8** support electronic circuits and other apparatus that perform the specified operations, and acts for performing the specified operations.

[0025] The terms “comprises” or “comprising” when used in this specification are taken to specify the presence of stated features, elements, steps, or components but do not preclude the presence or addition of one or more other features, elements, steps, components or groups thereof.

[0026] Further, the term “communication device” as used herein may include, but is not limited to, a Bluetooth device, a wireless local area network (WLAN) device such as compliant with IEEE 802.11, a cellular terminal; a personal communication device that may combine wireless communication ability with data processing, facsimile, data communications capabilities and/or global positioning system (GPS) receiver; a personal digital assistant (PDA) that may include wireless communication ability; a pager; satellite communications equipment; and infrastructure equipment with wireless communication ability; or any devices that may communicate through other equipment that provides wireless communication ability.

[0027] A frequency-hopping (FH) communication device **100** according to embodiments of the present invention is shown in **FIG. 1**. The communication device **100** includes an antenna **110**, a transceiver **120**, and a processor **130**. The processor **130** provides an information signal to the transceiver **120** for transmission. The transceiver **120** may code, modulate, and upconvert the information signal to a hop channel, and transmit the signal via the antenna **110** to another communication device. Likewise, the transceiver **120** may receive, downconvert, demodulate, and decode a signal received on a hop channel to provide information to the processor **130**.

[0028] The communication device **100** may transmit and receive signals on sequences of time-varying hop channels within a band of hop channels. The sequence of channels among which communications hop may be selected in a random, pseudorandom, and/or sequential manner. For Bluetooth and IEEE 802.11 WLAN communication devices, a random or pseudo-random hop sequence may be required for compliance with the respective industry specifications.

[0029] The communication device **100** may use the unlicensed ISM band at 2.45 GHz, which is illustrated in **FIG.**